APPENDIX A: DATA SOURCES

In addition to original research, this study relies on the authorizing statutes, relevant Executive Orders, the peer-reviewed literature, guidance such as EPA's *Guidelines for Preparing Economic Analyses* (U.S. Environmental Protection Agency 2000), and prior external analyses of the program (e.g., Office of Technology Assessment 1989; Hird 1994; Probst and Konisky 2001; Hamilton and Viscusi 1999) for concepts, methods, and data.

Because much of this study consists of benefits transfer analysis of one sort or another, previous research provides much of the "data." An exhaustive review is unnecessary here—see the appropriate chapters—but a representative list might be: EPA cost of illness handbook (U.S. Environmental Protection Agency 2002); a variety of epidemiological studies (Lidsky and Schneider 2004; Yoshida, Yamauchi, and Sun 2004; Vrijheid 2000; Horton, Berkowitz, and Kaye 2004); reviews of risk assessments at NPL sites (Walker, Sadowitz, and Graham 1995; Hamilton and Viscusi 1995); and hedonic data (Boyle and Kiel 2001); NRDAs (Damage Assessment and Restoration Program (DARP) 2004; Office of Environmental Management 1997).

Below are descriptions and information regarding the location of additional data sources used in the current study.

Table A.1. Data Source Descriptions

Data Source	Description
Archived Sites	The EPA maintains a database of archived sites. "Archive designation means that assessment at a site has been completed and EPA has determined no steps will be taken to designate the site as a priority by listing it on the National Priorities List (NPL). No further remedial action is planned for these sites under the Superfund Program." This database can be accessed online at http://cfpub.epa.gov/supercpad/arcsites/srchsites.cfm.
ATSDR PHA database	Agency for Toxic Substances and Disease Registry's (ATSDR's) public health assessments from October 1994 to the present are available online. This database can be accessed online at http://www.atsdr.cdc.gov/cgi-bin/search-pha.
ATSDR CEP database	ATSDR maintains a database which lists the hazardous substances found in completed exposure pathways (CEPs) at every site. This database is not available online.
ATSDR 2003	This Web Site lists the number of sites at which completed exposure pathways (CEPs) exist for the hazardous substances most often found in CEPs. This source can be found online at http://www.atsdr.cdc.gov/cep.html.

Table A.1. (Continued)

Data source	Description
CERCLIS	"CERCLIS is the Comprehensive Environmental Response, Compensation, and Liability Information System. CERCLIS contains information on hazardous waste sites, potential hazardous waste sites, and remedial activities across the nation, including sites that are on the National Priorities List (NPL) or being considered for the NPL." "CERCLIS offers a variety of search criteria, such as site name, state, ZIP code, contaminants, HRS score and remedial activities. You can also retrieve additional site-specific documents and records such as Records of Decision, Five-Year Reviews and fact sheets for many sites." This is a database maintained by EPA. Portions of it are available through a public on-line search at http://www.epa.gov/superfund/sites/cursites/. More in-depth searches are available by contacting EPA directly.
CLU-IN Web Site	"The Hazardous Waste Clean-Up Information (CLU-IN) Web Site provides information about innovative treatment and site characterization technologies to the hazardous waste remediation community. It describes programs, organizations, publications, and other tools for federal and state personnel, consulting engineers, technology developers and vendors, remediation contractors, researchers, community groups, and individual citizens. The site was developed by the U.S. Environmental Protection Agency (EPA) but is intended as a forum for all waste remediation stakeholders." The Web Site can be accessed at http://www.clu-in.org/.
Envirofacts Data Warehouse	The Envirofacts Data Warehouse is a "one stop source for environmental information" maintained by EPA. It offers information by topic, as well as advanced information in the form of queries, maps, and reports. This source can be accessed at http://www.epa.gov/enviro/index.html.
EPA REACH IT	The Remediation and Characterization Technology Database, "EPA REACH IT, is a system that lets environmental professionals use the power of the Internet to search, view, download and print information about innovative remediation and characterization technologies… It gives users access to comprehensive information about treatment and characterization technologies and their applications. It combines information submitted by technology service providers about remediation and characterization technologies with information from EPA, the U.S. Department of Defense (DoD), the U.S. Department of Energy (DOE), and state project mangers about sites at which innovative technologies are being deployed. Those sources together provide you with up-to-date information, not only about technologies you can use to characterize or remediate a site, but also about sites at which those technologies are being used and the service providers that offer them." EPA REACH IT is sponsored by EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) and can be accessed at http://www.epareachit.org/.

Table A.1. (Continued)

Data source	Description
Five-Year Reviews OnLine	"Five-Year Reviews Online is the source for obtaining Five-Year Reviews, documents prepared by EPA to evaluate the implementation and performance of site remedies to determine if they remain protective of human health and the environment. Using Five-Year Reviews Online, you can search by state, site name or EPA ID, region, keyword, or fiscal year across all available Five-Year Reviews." This source can be accessed at http://www.epa.gov/superfund/sites/fiveyear/index.htm.
HazDat	"HazDat, the Agency for Toxic Substances and Disease Registry's Hazardous Substance Release/Health Effects Database, is the scientific and administrative database developed to provide access to information on the release of hazardous substances from Superfund sites or from emergency events and on the effects of hazardous substances on the health of human populations. The following information is included in HazDat: site characteristics, activities and site events, contaminants found, contaminant media and maximum concentration levels, impact on population, community health concerns, ATSDR public health threat categorization, ATSDR recommendations, environmental fate of hazardous substances, exposure routes, and physical hazards at the site/event. In addition, HazDat contains substance-specific information such as the ATSDR Priority List of Hazardous Substances, health effects by route and duration of exposure, metabolites, interactions of substances, susceptible populations, and biomarkers of exposure and effects. HazDat also contains data from the U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database, including site CERCLIS number, site description, latitude/longitude, operable units, and additional site information." HazDat can be accessed at http://www.atsdr.cdc.gov/hazdat.html.
HSEES	"The Hazardous Substances Emergency Events Surveillance (HSEES) system was established by ATSDR to collect and analyze information about releases of hazardous substances that need to be cleaned up or neutralized according to federal, state, or local law, as well as threatened releases that result in a public health action such as an evacuation. The goal of HSEES is to reduce the morbidity (injury) and mortality (death) that result from hazardous substances events, which are experienced by first responders, employees, and the general public." HSEES can be accessed at http://www.atsdr.cdc.gov/HS/HSEES/.

Table A.1. (Continued)

Data source	Description
IEUBK Model	"The Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) attempts to predict blood-lead concentrations (PbBs) for children exposed to lead in their environment. The IEUBK model allows the user to input relevant absorption parameters (e.g., the fraction of lead absorbed from water) as well as intake and exposure rates. Using these inputs, the model rapidly calculates and recalculates a complex set of equations to estimate the potential concentration of lead in the blood for a hypothetical child or population of children (6 months to 7 years of age)." This model is made available online by the EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) at http://www.epa.gov/superfund/programs/lead/ieubk.htm.
Record of Decision System	The Record of Decision System (RODS database) is maintained by EPA. "These decision documents describe the chosen remedy for site remediation. They also include detailed site description, history, and contaminants. The RODS database includes Amendments and Explanations of Significant Differences which describe both minor and significant changes from the original remedy stated in the ROD, such as a contingent remedy or new technology. RODS can be searched for a specific document or across the entire database by keyword." This database may be accessed at http://cfpub.epa.gov/superrods/srchrods.cfm.
U.S. Census Bureau (data from 1980, 1990, 2000)	Selected historical and decennial census population and housing counts are available from the Census Bureau. The Census Bureau also has released detailed reports from past censuses (1790 on) and past Statistical Abstracts online. In addition, a research and photocopy request can be submitted for historical census population data not available online. The Census Bureau's internet site can be accessed at http://www.census.gov/.
U.S. Geological Survey Ground-Water Data for the Nation	"The Ground-Water database contains ground-water site inventory, ground-water level data, and water-quality data." This database along with GIS map layers is available at http://waterdata.usgs.gov/nwis/gw.

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APPENDIX B: CASE STUDIES

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APPENDIX C: ALTERNATIVE BASE-YEAR FOR DISCOUNTING (2004)

The tables and figures presented in the results and discussion in Chapter 4 of the current study are presented with a base-year for discounting of 1980. The figures and tables presented in this appendix represent the alternative base-year of 2004 for discounting. Table C.1 is a replication of Table 4.6, while Table C.2 contains the alternative calculations for Table 4.7.

The present values (PVs) of the benefits transfer analysis presented in Chapter 4 of the current study are shown in Tables C.1 and C.2 and Figure C.1, along with the 95% confidence intervals.[1] Values for discount rates of 3% and 7% are given. For convenience, only the 3% values are discussed here. The mean values for the four models range from $130-$210 billion over the period 1980-2004. The 95% confidence intervals range from a low of $84 billion to a high of $260 billion.

Each of the four models and the data used to estimate the parameters in each (specifically, the magnitude of the price effect, see Chapter 4) has different advantages and disadvantages. The Linear Absolute (LA) model has the largest amount of data associated with it, but it is the least theoretically appealing model. On the other hand, the most theoretically appealing model, the Non-Linear Percentage (NLP) model is supported by only a few studies. The issue thus becomes, partly, which provides a greater improvement over the LA model--using a percentage-based model or using a non-linear model? Given the close agreement of the absolute and percentage models, using a non-linear model probably provides more advantage. Considering both functional form and data quality, the results that are probably the most reliable come from the Non-Linear Absolute (NLA) model. Thus, the best point estimate of the present value (r=3% in 2000$) of the benefits of NPL remedial actions for the first 25 years of the Superfund program, using a base-year of 2004, appears to be about $130 billion.

These calculations are fairly sensitive to the maximum distance at which the price effect is assumed to operate. If this effect is only one mile, the benefit drops by about 70%; if it extends all the way out to four miles, the benefit may be twice as large as the values shown in Figure C.1. Note that only one of the studies in Table 4.2 found a non-linear effect extending past three miles, so non-linear results for four miles were not calculated. These calculations are less sensitive to assumptions about the price effect for non-single occupancy, detached (non-SOD) residences. If non-SOD homes experience only half the effect of SOD homes (for which there is no evidence), mean estimates of the benefits range from about $97-$160 billion.

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[1] The present value of a series of benefits (or costs) that occur in the future (in this case, annually) is equal to the sum of the individual benefits (or costs) discounted into present-day terms. The equation for discounting is $PV = B/(1+r)^t$ where B is the benefit, r is the discount rate, and t is the number of years in the future. The conceptual framework for discounting is based on the fact that present consumption is valued more than future consumption.

Table C.2 presents annualized values of these benefits, which is another way (in addition to present values) of expressing the magnitude of benefits that vary across time.[2] The annualized benefits of NPL remedial actions, using the assumptions and methods given above, range from $3.4-$5.5 billion per year over the period 1980-2004, depending on the model used and assuming a 3% discount rate. The 95% confidence interval is $2.2-$6.9 billion per year.

In comparing the values in Appendix C (base-year 2004) with those in Chapter 4 (base-year 1980), the present value of benefits are higher in 2004 while the annualized values are higher for 1980. The reason for this has to do with the details of discounting calculations, which reflect the preference for consumption sooner rather than later. Discounting back to the past (as in Chapter 4) tends to reduce the value of benefits that occur late in the period, while discounting forward in time (as in this appendix) tends to increase the value of the earlier benefits. Thus discounting forward yields a larger present value.

The reason that the 1980 annualized value is higher is that the pattern of actual benefits is skewed towards the beginning of the period. Discounting back to the past (as in Chapter 4) subjects the values at the end of the period to more compounding than those at the beginning, and the reverse occurs when discounting forward. If more benefits occur in the early part of the period, as is the case for the benefits calculated in Chapter 4, this effect makes the annualized value for a base-year at the beginning of the period somewhat larger than for a base-year at the end of the period.

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[2] An annualized benefit is the size of a fixed annual benefit, which, if it occurred at the end of each year and was discounted forward to the base year (2004, in this case) would result in the same present value as the actual series of benefits. Thus, calculating an annualized benefit converts a series of unequal benefits to a series of uniform benefits, both of which have the same present value.

Table C.1. Present Value of the Benefits of NPL Remedial Actions, 1980-2004
(Billion 2000$, Base-year 2004)

r = 7%	Value	Model			
All residence types equivalent		LA	NLA	LP	NLP
Max distance 2.5 mi.	Mean	260	210	350	250
	95% CI	180-330	150-280	260-430	140-370
50% effect for non-SOD homes	Mean	190	160	260	180
Max distance 1 mi.	Mean	73	-	-	-
Max distance 4 mi.	Mean	480	-	-	-
r = 3%	Value	Model			
All residence types equivalent		LA	NLA	LP	NLP
Max distance 2.5 mi.	Mean	160	130	210	150
	95% CI	110-200	89-170	160-260	84-230
50% effect for non-SOD homes	Mean	120	97	160	110
Max distance 1 mi.	Mean	44	-	-	-
Max distance 4 mi.	Mean	290	-	-	-

Table C.2. Annualized Value of the Benefits of NPL Remedial Actions, 1980-2004
(Billion 2000$, Base-year 2004)

r = 7%	Value	Model			
All residence types equivalent		LA	NLA	LP	NLP
Max distance 2.5 mi.	Mean	3.5	2.9	4.7	3.4
	95% CI	2.4-4.6	2.0-3.8	3.5-5.9	1.9-5.1
r = 3%	Value	Model			
All residence types equivalent		LA	NLA	LP	NLP
Max distance 2.5 mi.	Mean	4.1	3.4	5.5	3.9
	95% CI	2.8-5.3	2.3-4.5	4.1-6.9	2.2-6.0

Figure C.1. Present Value of the Benefits of the NPL Site Remedial Activities, 1980-2004 (Billion 2000$, Base-year 2004)
Mean and 95% C.I. shown. Price effect for all homes is the same.

Benefits of NPL Remedial Actions 1980-2004 (PV in 2004)
Mean and 95% C.I. shown. Price effect for all homes is the same.